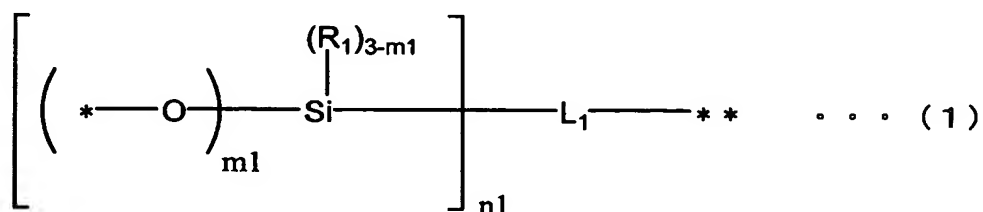


What is claimed is:

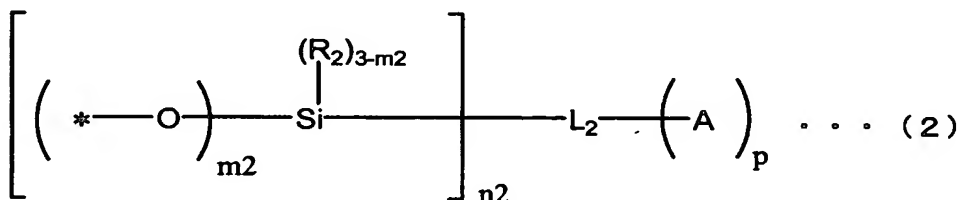
1. A proton-conductive membrane having a structure with a group that contains an organic molecular chain and a proton-donating group being covalent-bonded to a silicon-oxygen three-dimensional crosslinked matrix therein, which contains
- 5 a partial structure represented by the following formula (1):



wherein  $R_1$  represents an alkyl group or an aryl group;  $L_1$  represents an  $(n1 + 1)$ -valent linking group;  $m1$  represents an integer of from 1 to 3;  $n1$  represents an integer of from 1 to 4;  $*$  indicates the position at which the group bonds to the silicon atom; and  $**$  indicates the position at which the group bonds to an organic polymer chain,

and a partial structure represented by the following formula

15 (2):



wherein  $R_2$  represents an alkyl group or an aryl group;  $L_2$  represents an  $(n2 + p)$ -valent linking group;  $A$  represents a proton-donating group;  $m2$  represents an integer of from 1 to 3;  $n2$  represents an integer of from 1 to 4;  $p$  represents an integer

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of from 1 to 3; \* indicates the position at which the group bonds to the silicon atom.

2. The proton-conductive membrane of claim 1, wherein  $R_1$  in the formula (1) is an alkyl group having from 1 to 10 carbon atoms.

3. The proton-conductive membrane of claim 1, wherein  $L_1$  in the formula (1) represents an alkylene group, an arylene group, -O-, or a linking group formed by combining two or more thereof.

10 4. The proton-conductive membrane of claim 1, wherein  $m_1$  in the formula (1) is 2 or 3.

5. The proton-conductive membrane of claim 1, wherein  $n_1$  in the formula (1) is 1.

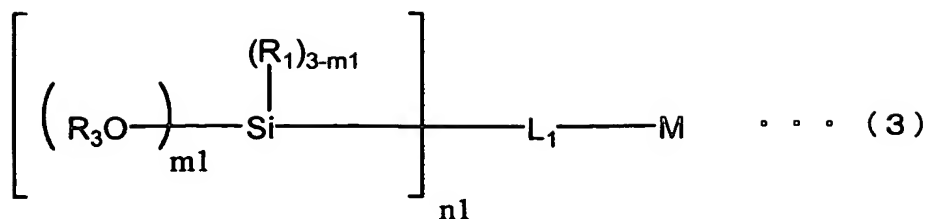
15 6. The proton-conductive membrane of claim 1, wherein  $R_2$  in the formula (2) is an alkyl group having from 1 to 10 carbon atoms.

7. The proton-conductive membrane of claim 1, wherein  $L_2$  in the formula (2) is an alkylene group, an arylene group, or a linking group formed by combining two or more thereof.

20 8. The proton-conductive membrane of claim 1, wherein  $m_2$  in the formula (2) is 2 or 3.

9. The proton-conductive membrane of claim 1, wherein  $n_2$  in the formula (2) is 1.

25 10. The proton-conductive membrane of claim 1, wherein the partial structure represented by the formula (1) is formed through sol-gel reaction of an organosilicon compound as a precursor represented by the following formula (3):

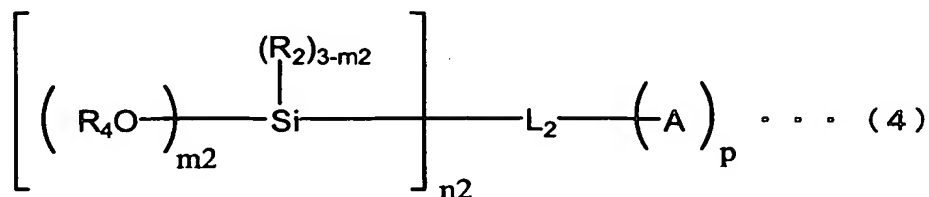


wherein  $R_1$  represents an alkyl group or an aryl group;  $R_3$  represents a hydrogen atom, an alkyl group, an aryl group or a silyl group;  $L_1$  represents an  $(n1 + 1)$ -valent linking group;  $M$  represents a polymerizable group that may form a carbon-carbon bond or a carbon-oxygen bond through polymerization;  $m1$  represents an integer of from 1 to 3;  $n1$  represents an integer of from 1 to 4; and when  $m1$  is 2 or more, then  $R_3$ 's may be the same or different.

11. The proton-conductive membrane of claim 10, wherein  $R_3$  in the formula (3) is an alkyl group having from 1 to 10 carbon atoms.

12. The proton-conductive membrane of claim 10, wherein  $M$  in the formula (3) is an ethylenic unsaturated residue, an epoxy group, or an oxetanyl group.

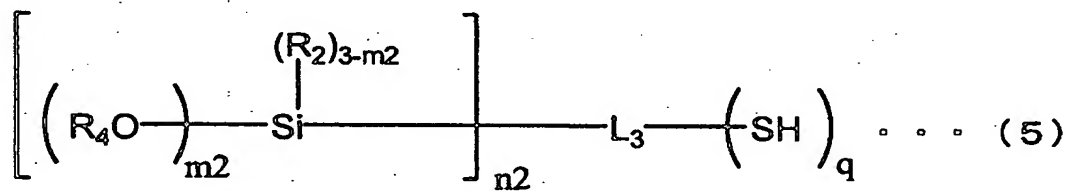
13. The proton-conductive membrane of claim 1, wherein the partial structure represented by the formula (2) is formed through sol-gel reaction of an organosilicon compound as a precursor represented by the following formula (4):



wherein  $R_2$  represents an alkyl group or an aryl group;  $R_4$  represents a hydrogen atom, an alkyl group, an aryl group or a silyl group;  $L_2$  represents an  $(n_2 + p)$ -valent linking group; A represents a proton-donating group;  $m_2$  represents an integer of from 1 to 3;  $n_2$  represents an integer of from 1 to 4;  $p$  represents an integer of from 1 to 3; and when  $m_2$  is 2 or more, then  $R_4$ 's may be the same or different.

14. The proton-conductive membrane of claim 13, wherein  $R_4$  in the formula (4) is an alkyl group having from 1 to 10 carbon atoms.

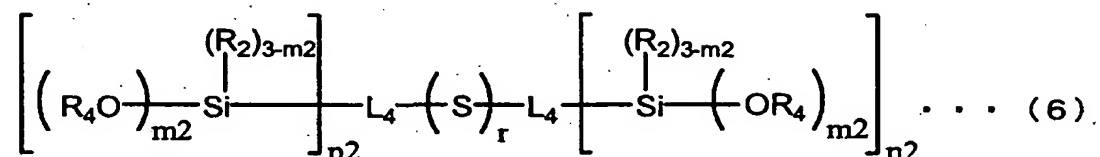
15. The proton-conductive membrane of claim 13, wherein the precursor represented by the formula (4) is a sulfonic acid sol prepared through oxidation of a solution that contains an organosilicon compound represented by the following formula (5):



wherein  $R_2$  represents an alkyl group or an aryl group;  $R_4$  represents a hydrogen atom, an alkyl group, an aryl group or a silyl group;  $L_3$  represents an  $(n_2 + q)$ -valent linking group;  $m_2$  represents an integer of from 1 to 3;  $n_2$  represents an integer of from 1 to 4;  $q$  represents an integer of from 1 to 3; and when  $m_2$  is 2 or more, then  $R_4$ 's may be the same or different.

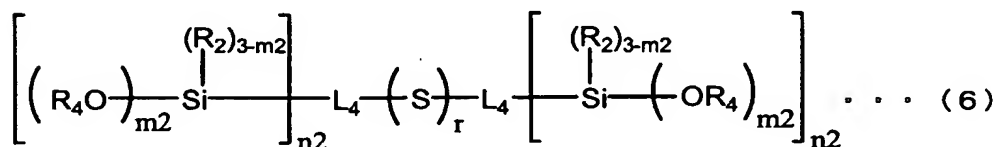
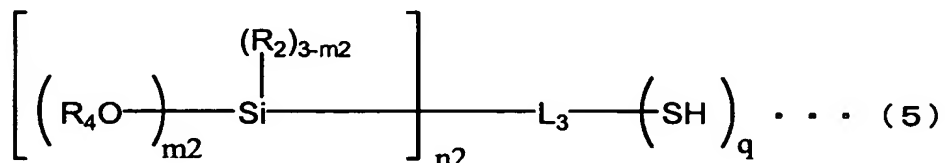
16. The proton-conductive membrane of claim 13, wherein the precursor represented by the formula (4) is a sulfonic acid sol prepared through oxidation of a solution that contains an

organosilicon compound represented by the following formula (6):



wherein  $R_2$  represents an alkyl group or an aryl group;  $R_4$  represents a hydrogen atom, an alkyl group, an aryl group or a silyl group;  $L_4$  represents an  $(n_2 + 1)$ -valent linking group;  $m_2$  represents an integer of from 1 to 3;  $n_2$  represents an integer of from 1 to 4;  $r$  represents an integer of from 2 to 5; and when  $m_2$  is 2 or more, then  $R_4$ 's may be the same or different.

17. The proton-conductive membrane of claim 10, which is formed through sol-gel reaction of a sulfonic acid sol and an organosilicon compound represented by the formula (3) wherein the sulfonic acid sol is prepared through oxidation with an oxidizing agent of a solution that contains an organosilicon compound represented by the following formula (5) and/or formula (6):



wherein  $R_2$  represents an alkyl group or an aryl group;  $R_4$

represents a hydrogen atom, an alkyl group, an aryl group or a silyl group;  $L_3$  represents an  $(n_2 + q)$ -valent linking group;  $L_4$  represents an  $(n_2 + 1)$ -valent linking group;  $m_2$  represents an integer of from 1 to 3;  $n_2$  represents an integer of from 1 to 4;  $q$  represents an integer of from 1 to 3;  $r$  represents an integer of from 2 to 5; and when  $m_2$  is 2 or more, then  $R_4$ 's may be the same or different.

18. The proton-conductive membrane of claim 17, wherein the oxidizing agent is hydrogen peroxide or peracetic acid.

10        19. A membrane electrode assembly comprising the proton-conductive membrane of claim 1.

20. A fuel cell comprising the proton-conductive membrane of claim 1.